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SCIENCE AND AN ORGANIZED CIVILIZATION¹

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SO pervasively is science woven into the very fabric of western civilization that no appeal is necessary in behalf of extending its sway or enhancing its security. Everybody now recognizes that agriculture, manufacture, transportation, war, sanitation and medicine simply could not exist in the modern sense but for the objective sciences.

Urgent questions there certainly are as to particular ways of making the several sciences still more widely applicable, and still more effective for the interests mentioned.

But vast and noble as are these services of science, yet when science is regarded from this standpoint chiefly, it connotes technology rather than a mode of expression of the human intellect and will and hand *per se*. And we must recognize that, in so far as science is thus restricted, it is rather an instrument of civilization than somewhat of the real essence of civilization.

My part in to-day's program is to exhibit science as an interpreter of, and a participant in, the deepest life of civilization itself rather than as an instrument of civilization. But before proceeding to the task proper, I must shield myself with a few sentences against the possible inference that my attitude toward applied science is one of lukewarmness or even of deprecation. So remote from me are such feelings that I do not regard any science, however "pure," to have attained full worth and dignity until application to human welfare of some sort

¹ One of four addresses presented in a symposium upon "Coordination and Cooperation in Research and in Applications of Science," held during the meeting of the Pacific Division of the American Association for the Advancement of Science at Leland Stanford Junior University, April 5 to 7, 1917. The other addresses presented upon this occasion were:

"The National Research Council as an Agency of Cooperation," by Arthur A. Noyes, Director of Chemical Research, Throop College of Technology, Pasadena, California.

"Plans for Cooperation in Research among the Scientific Societies of the Pacific Coast," by J. C. Merriam, Professor of Paleontology, University of California, Berkeley.

"The Applications of Science," by William F. Durand, Professor of Mechanical Engineering, Leland Stanford Junior University, California.

has been found for it beyond the intellectual interest it may have to a few intense delvers in each particular specialty. The kernel of my view touching this matter is that all scientific investigation, no matter what may be done with the results after they are attained, must be pure in the sense that it must throb with devotion to the *pure truth* sought, otherwise it will be frail and misshapen, and timorous of the light of the common day. The publicly expressed policies and the accomplished work of the research institution for which I am in a measure responsible constitute, I venture to hope, evidence that my views on this matter are not entirely theoretic.

The initial contentions of the argument I present to-day are two: no federation or compact of nations can possess the elements of measurable permanency and usefulness the main roots of which do not reach clear through the layers of social custom, formulated law, and ordinary political organization and convention, and penetrate deep into the nature of man himself; and second, that such an understanding of man as this implies is the province of science, primarily. Biological anthropology, with special regard to its psychological aspect, is the only source of material for a proper foundation on which to erect a truly useful and durable international structure.

I am familiar with the opinion held by many jurists, statecraftsmen, publicists, teachers, ministers of religion and philosophers that they alone are the custodians of man's higher welfare, and that the occasional incursions of science into their provinces are more productive of harm than of good. Many who speak for these groups are particularly outspoken in the present distracted time against the effort to "drag biology into human affairs." Now we men of science must acknowledge fully and openly that this feeling toward science and toward us as students and apologists of science has much to justify it in certain ideas and undertakings of ours. The gigantic and rather easily won successes scored by many branches of science in these later decades have tended to make many scientists impatient, even scornful of that rigor and comprehensiveness of thinking which for centuries have characterized mathematics, formal logic and the main schools of western philosophy. Nor have the sciences, while winning for themselves institutional place and communal standing, kept themselves above that very same arrogance of learned caste for the overcoming of which at an earlier time science had to join combat with the old disciplines. Great and powerful, and at heart noble as is the science of our day, it yet is distinctly

poorer than it formerly was in that it has lost something of that manly boldness and the chivalry of its heroic periods.

But nothing is more patent once any one, whether humanist or scientist, tutors himself broadly and reflectively, than the fact that to maintain humanistic learning in complete and splendid detachment from scientific learning is no more possible than it is to maintain the dining-room of a household in complete detachment from the kitchen. The statesman who would exclude the biologist and the anthropologist from any voice in problems of government and social and industrial justice would be in like case with an orange producer who would exclude the botanist and horticulturist from a voice in the problems of good and abundant oranges. Oranges and oranges for dividends, the orchardist might argue, is what he is after, and men who busy themselves with such things as roots and wood and leaves and soil are too remote from his interests to figure in his calculations.

To all those who in our day proclaim the theory that science is really something apart from the deeper, the spiritual welfare of humanity, I call attention to a historical fact which appears very remarkable when viewed in the light of that theory. The fact referred to is that beyond question many of those writers on society, government and law who have spoken to us out of the earlier and intermediate centuries and who have influenced civilization most profoundly have avowedly taken nature and the nature of man as their starting point and constant base of reference.

I have recently given offence, I fear, to friends who are professionally occupied with the literature and philosophy of ancient Greece, by affirming that it is impossible for any one to understand Aristotle either in letter or spirit who does not know him as a naturalist—as a zoologist. Acquaintance with the “Parts of Animals” and the “Generation of Animals” and the “History of Animals” is, I insist, as indispensable to an understanding of the “Politics,” the “Poetics” and the “Ethics” as is acquaintance with the Constitution of the United States to an understanding of our national and state governments.

And who that has dipped even his finger-tips into the learning and the thoughts with which Cicero enriched the world can have missed being impressed by his appeals to what, following the Greeks, he calls “the first natural impressions”? *De Finibus* is especially permeated with such phrases as “the principles of nature.”

Probably no single author illustrates the point quite so vividly and dramatically as J. J. Rousseau. A recent commentator on Rousseau has expressed, in effect, the opinion that probably no other author whatever, modern or ancient, has put so powerful a ferment into social and governmental theory as Rousseau. And his own story of his life, as told in the *Confessions*, reveals even more clearly, if that is possible, than his formal treatises, the extent to which his exhortation "back to nature" was basic to his whole scheme. And of far more than historic interest for us in this country to-day is the fact that the entire sociological and political school of eighteenth-century Frenchmen of which Rousseau is, I believe, usually held to be the climactic figure, was first and foremost a nature-of-man school. This fact has, I say, more than a mere historic interest for us, in that our own national ideals and ideas send their roots directly back into that school, especially through Thomas Jefferson.

But the author to whom I find it advantageous to give a focal place in my discussion to-day is Hugo Grotius, the great Dutchman generally accepted as the father of international law. Few things seem to be more significant for us now than the circumstances under which his epochal book, "*De Jure Belli ac Pacis*," was composed, and his appeal to human nature in this work.

Listen to the full title of the book put into English: "The Rights of War and Peace, including the Law of Nature and of Nations." The Law of Nature and of Nations! Is there one in this audience who has read somewhat at length in the writings of the fathers of our nation to whom this phrase is unfamiliar? Whether the expression originated with Grotius or not I do not know, but certain it is that he made it his very own, and gave it a life and meaning that it had never had before. As one goes through the pages and chapters of his book, he becomes aware that an equally true title for it would be "The Law of Nature in its relation to War and Peace."

And what is the kernel of the whole matter? That the law of nations is essentially the same thing as the law of nature, and that the law of nature, especially as it expresses itself in the nature of man, is the supreme law of the universe, even the Divine Law not excepted. God Himself, Grotius points out repeatedly, is unable to set at naught the law of nature. Divinity, he naïvely reminds us, is incapable of making five out of twice two.

Reflect now on the circumstances under which the Rights of

War and Peace was produced. The work was written in the midst of the Thirty Years' War, and concerning the general situation the Honorable David J. Hill has said:

Looking about him at the general havoc which war had made, the nations hostile, the faith of ages shattered, the passions of men destroying the commonwealths which nourished them, Grotius saw that Europe possessed but one common bond, one vestige of its former unity—the *human mind*. To this he made appeal and upon its deepest convictions he sought to plant the law of nations.

With this quotation another phase of our discussion is reached. The havoc of great war with its wreckage of former unities and of faiths affected Grotius as apparently it tends always to affect men. It left visible to him only one common bond among the peoples of Europe—"the human mind"—in Mr. Hill's language.

Even so with us to-day, the world cataclysm filling our eyes, our ears, our intellects and our hearts. Human nature stands before us almost stark naked. Hardly any of the former garments of political, social and industrial order hide its form. And so like Grotius we ought to scrutinize that naked body as under normal conditions it is hardly possible to scrutinize it.

And here comes a measure of uniqueness in my contention. Such a time of shattered custom and law as this is exactly one which reveals the need of, which gives the opportunity to, science. In former centuries, before great differentiation of the province of learning had taken place, the doctors of law might well undertake to study man himself after the garments of law were stripped from him. Not so to-day, when the field of learning is parcelled among so many doctors. Those of science, especially those of biological anthropology and psychology, and not alone those of law and normal society, are designated by the problems themselves and by the character of our era to play a conspicuous part in the making of peace and the reestablishment of order when the time for that business shall come.

To show more specifically the ground on which this contention rests, and to indicate two or three points at which the service of science is especially urgent, is the task for the few minutes remaining to me. What I have to say under this head may be fittingly introduced by the following quotation from Grotius:

Aristotle, taking a description of man from his peculiar qualities, makes him an animal of a gentle nature, and in another part of his works, he observes that in considering the nature of man, we are to take our likeness from nature in its pure and not in its corrupt state.

The train of reflection initiated by this statement is this: The principle of procedure followed by Aristotle and less faithfully by Grotius in dealing with man on the basis of his fundamental nature, is right as to broad outlines, but viewed in the light of modern natural history and anthropology is wholly inadequate as to details. Let me explain. The principle is right in so far as it "describes man from his peculiar qualities," using Grotius's phrase, and in so far as it "takes our likeness from nature in its pure and not in its corrupt state," speaking again in Grotius's phraseology. The inadequacy appears under two aspects, one pertaining to substance, the other to form.

Before treating of these two aspects specifically it will be well to state the case in a form which brings it to our own times and conditions: The whole vast body of discussion of man under western civilization, as this appears in writings on society, government, law, ethics and the rest, is radically defective in that it rests on no adequately scientific definition of man. Incalculably far-reaching as this criticism is, the warrantableness of it becomes clear and unescapable once the matter is approached from the direction from which Aristotle, and in part Grotius, approached it, and is followed through on the basis of later progress in the sciences of man.

To take up now the technical or scientific view of the matter spoken of a moment ago as having two aspects, one of substance, the other of form. This leads us to requisition that great province of natural knowledge in which Linnæus is the dominating figure, namely, that of the systematizer; and the equally great province in which Charles Darwin stands pre-eminent, that of inquirer into the origin of kinds of living beings. Only the most vital spots in the gigantic situation can receive attention here. Let us remind ourselves of Huxley's eminently just characterization of Linnæus as the supreme lawgiver of living nature. Reflect on what he did to advance man's interpretation of himself over what Aristotle had done. Aristotle had rightly, though only partially and wholly empirically, defined man "from his peculiar qualities," and had seen that logical consistency demanded that these peculiar qualities should have reference to man "in his pure and not in his corrupt state."

But it remained for Linnæus to bring out that this mode of defining man fixed his place not empirically or arbitrarily, but naturally and inevitably, in the vast *system* of living nature, and that it placed him at the head of this system. Paltry though Linnæus's contribution to man's understanding of him-

self was as compared with Aristotle's, when the *substance* of it is concerned, because of the *form* he was able to impress upon that substance his service to humanity was very great, for it amounts to a veritable natural revelation to man of what his place is in the system of the universe. I am convinced that his service in this has been rarely recognized with sufficient fullness either by scientists or humanists. Think a moment about what he really did on the basis of the knowledge that had been accumulated concerning the physical characters of animals and man. He was able to recognize man not only as belonging to the animal kingdom, but to the class mammalia, to the order primates, and to assign him to a genus, *Homo*, in that order. Then on the basis of man's "peculiar qualities," reverting again to Grotius's statement of Aristotle's method, he undertook to define the kind, or species man, and subdivide it into several sub-kinds or races. And here comes the point which, so far as man's own welfare is concerned, is most vital, though it is usually regarded in the lightest way or not at all, especially, I fear, by present-day biologists. What "peculiar qualities" of *Homo sapiens* were they to which Linnæus appealed in his efforts at systematizing the species? Why, those of habit, of location, of educability, of temperament, of esthetic impulse, of relation to law and government, and of rational and moral life. All this is set down after the usual synoptic fashion followed by Linnæus in the "*Systema naturæ*." So much for what this lawgiver of living nature bulided into the great edifice of man's understanding of himself: On the basis of his physical attributes he assigned man to the natural order; and on the basis of his civilizational or spiritual attributes he isolated man *within* that order, and subdivided him into lesser groups.

Turn now for a moment to what that other master builder, Charles Darwin, put into the same edifice. Great as was Grotius's regard for and adherence to the laws of nature, he still was unable to conceive that some of man's most distinctive attributes could have come from this source. "Who for an instant would say," he remarks, "that the Christian precept of laying down our lives for others was an obligation of the law of nature?"² Yet exactly this obligation Darwin showed to inhere in the natural law of organic creation and existence, for he showed in a manner which has carried conviction to all critical minds that man in the whole scope of his being is a natural product, and he also accepted the criterion of self-sacrifice as the most positive of all for man's nature.

² "The Rights of War and Peace," Chap. II., Sec. VI.

I must pause a moment to call attention to the meagerness of understanding of Darwin's position in this matter. His own words leave absolutely no room for doubt. The opening sentence of Chapter III. of the "Descent of Man," the beginning of the discussion of the moral sense, is as follows :

I fully subscribe to the judgment of those writers who maintain that, of all the differences between man and the lower animals, the moral sense or conscience is by far the most important.

Nor does he leave us in the least doubt as to a part at least of the meaning he attaches to moral sense. He says :

This sense, as Mackintosh remarks, "has rightful supremacy over every other principle of human action"; it is summed up in that short but imperious word *ought*, so full of high significance. It is the most noble of all the attributes of man, leading him without a moment's hesitation to risk his life for that of a fellow-creature; or, after due deliberation, impelled simply by the deep feeling of right or duty, to sacrifice it in some great cause.

With the exceedingly important matter of Darwin's effort to bring this attribute of man into harmony with his hypothesis of survival of the fittest we are not now concerned. Enough for this presentation to know that he recognized the attribute in the fullest possible way, and held it to be as natural to man as any of his other attributes.³

From these excursions into the ideas and methods of Aristotle, of Grotius, of Linnæus and of Darwin, we are now prepared to extract from the vast accumulation of knowledge, ancient and modern, of the natural history of the human species, a summary definition of that species which would be a fairly adequate foundation for the discussion of and the practical conduct of man under civilization.

The most distinctive thing about this definition as compared with definitions, expressed or implied, that have usually passed muster, is its recognition of the necessity of being comprehensive—of including all the major groups of attributes of man—instead of focusing on one group with the theory that these are cardinal while all the others are secondary and tributary to it. In other words, the revised definition is made in accordance with the maxim "neglect nothing" which is of growing importance in taxonomic biology. Leaving aside the purely physical peculiarities merely for the sake of brevity and on the assumption that they are obvious to all, and without pretending

³ Dr. George Nasmyth ("Social Progress and the Darwinian Theory," New York, 1916) has dealt more adequately with this aspect of Darwin's teachings than has any other author with whom I am acquainted.

to exhaustiveness, the definition runs somewhat thus: Man is a speaking, esthetic, religious, thinking, political, economic, moral and idealizing animal.

A cardinal thing about this definition is not merely its comprehensiveness, though that is greatly important, nor yet the finality of delimitation and sequence of the several groups of attributes; but the indubitable reality, and the basic functional interrelation of all the groups.

And do not fail to notice that while the assertions that man is an eating, propagating, mating, fearing and fighting animal are true also, they can not be included in the definition of man *as man* for the reason that they are equally true of all animals. We here see again the great importance of the natural history method; that is, the method of defining organic beings by *taxonomic groups*, first clearly recognized by Linnæus. Definitions of this sort are characterized as much by what they *exclude* as by what they *include*. Even a partially adequate treatment of this matter would necessitate a whole course of lectures. I can now do no more than assert dogmatically that a prodigious amount of not only false but, scientifically viewed, foolish theorizing about civilized man has been carried on because of failure to recognize this principle. For example, the "wolf" theory of modern business and politics comes under the latter stigmatization. A man and a wolf are animals of very different nature—of widely separated taxonomic rank, so that from the natural history standpoint it is simply ridiculous for the species *Homo sapiens* to try to act not in accordance with its own nature, but in accordance with the nature of some other species, as a wolf. How does it happen, one may ask, that men should have hit upon the wolf rather than upon the hog in attempting to shunt moral responsibility for their deeds from themselves to their animal natures? From a purely scientific standpoint one course is as justifiable as the other. A man might exactly as well rely upon his odor-producing peculiarities in his "struggle for existence" because a skunk does so, as to rely upon his rapacity because a wolf does. To taxonomic biology these cases are entirely parallel.

From the many lines of possible consideration which naturally radiate from this perception of the nature of man I select only one with which to end this paper. That is the radius which starts from the part of the definition which recognizes man to be an economic—a wealth-accumulating—animal. This is chosen for the reason that it seems to me to be the most important of all in this particular world crisis. Despite the

obviously enormous importance for the future of international relations, of man's political nature, his economic nature is still more important.

I am unable to understand how any measurably intelligent and thoughtful person can fail to see the futility of hoping for and working in behalf of immunity from military war among civilized peoples so long as these same peoples conceive industry and commerce as being in their essential nature a sort of war. If all the nations of the world, as well those engaged as those not engaged in the present military struggle, are in very truth planning for the "war after the war" about which we have heard so much, proposals looking toward permanent peace among the nations are as futile as would be proposals to reclaim the tropical lands of the earth by so shifting the earth's axis as to make those lands temperate instead of tropical.

I fully agree with the view so admirably expressed by President Wilson in his epochal war message that no basis for a peaceful and mutually advantageous compact among nations exists so long as the present German theory of the state prevails in even one powerful member of the "family of nations."

But even were all government claiming responsibility to itself and God alone done away with, the civilized world as now constituted would be a long way from insured against devastating wars. Men's fighting instincts do not depend alone or even chiefly on the form of government under which they live. Now, since economic needs and tendencies are not less strong under popular than under autocratic rule, and since the group of attributes upon which economic life has depended has dominated all other groups in the later decades, the good of mankind for the future is really as much dependent on bringing these attributes into proper subordination and correlation with the other major human attributes as on anything else whatever.

Speaking in terms of organic evolution, this world war is a time of metamorphosis of world civilization. If the titanic transformation taking place before our eyes shall be progressive rather than retrogressive the economic system of civilization will, we may confidently predict, emerge no less profoundly modified than will the governmental systems. "This commercial age of ours" must be approaching its end if civilization is passing to a higher plane. Economism, as several generations have understood the word, does insufferable violence to some of the profoundest instincts, the most precious interests of human life, and can not survive in that higher civilization

toward which the imagination and the ideals of all thoughtfully good men are turned.

What part has science to play in the yet unacted portion of the mighty drama? That is the specific question to which this address would contribute something. An attempt to answer the query in detail is neither possible nor necessary in this place, but a reply in broadest outlines is ventured.

1. Biology may undertake to convince the world that the prevalent custom of invoking the doctrine of the survival of the fittest in palliation, even in justification, of unhuman methods in business, politics and war rests on a deep misunderstanding of the evolutionary processes.

2. Anthropology may undertake to convince those historians, economists and publicists who have been committed to the extreme materialistic conception of human history and the extreme economic theory of human society that these doctrines imply a definition of the human species which is found to be very inadequate and largely fallacious when viewed in the light of natural history.

3. Chemists, physicists, geologists, agriculturists and breeders of plants and animals may undertake to convince the world that the latent resources of the lands and waters of the world are sufficient to insure the continued progress of our species in civilization, provided civilization be understood to consist in the harmonious growth and interplay of all the great groups of attributes which differentiate man most sharply from other animal species, and provided that the resources of the whole earth are utilized in accordance with the dictates of common wisdom and common justice and developed through the applications of science. And finally,

4. Scientific men and women of the whole world might, it would seem, unite in an effort to convince the statesmen, diplomatists and lawyers upon whom alone, according to precedent would fall the stupendous task of making peace and re-establishing political and economic and social order at the end of the war, that the voice of science ought to be far more definitely and authoritatively heard in the business than it ever has been before, this voice to be particularly invoked in the two supreme problems of colonial possessions and the use of the seas.